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(56) Documents Cited
GB 2242304 A GB 2151410 A GB 1304282 A

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(54) **Heat shield**

(57) A heat shield (10) which is able to absorb transient surges of heat and release it over an extended time period comprises a containing layer (12) which contains a working material (14) which undergoes a reversible phase change from solid to liquid in the temperature range between 40 degrees centigrade and 200 degrees centigrade. The working material is retained within the containing layer by sealing layers (16, 18). An insulating layer (20) and a reflective layer (22) may also be provided. The working material (14) may be a hydrate and the containing layer (12) may be a foam or a felt, eg. of plastics.

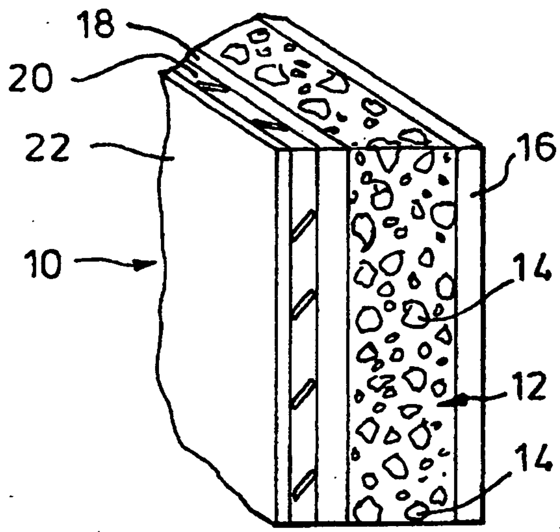

FIG.1

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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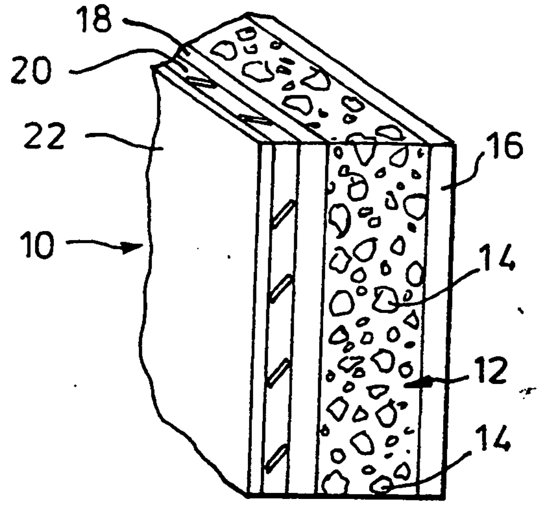

FIG.1

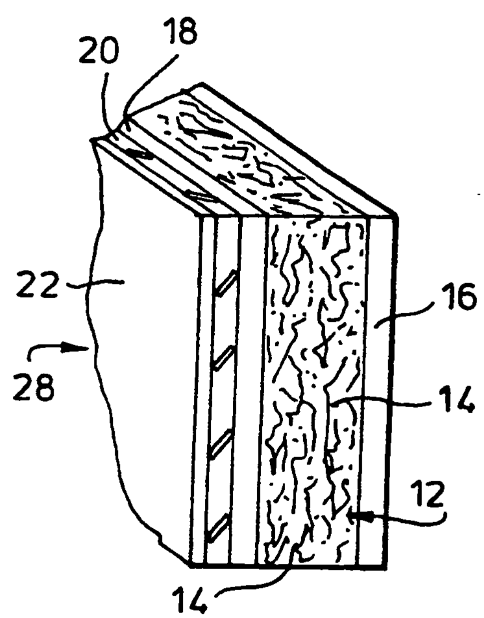

FIG.2

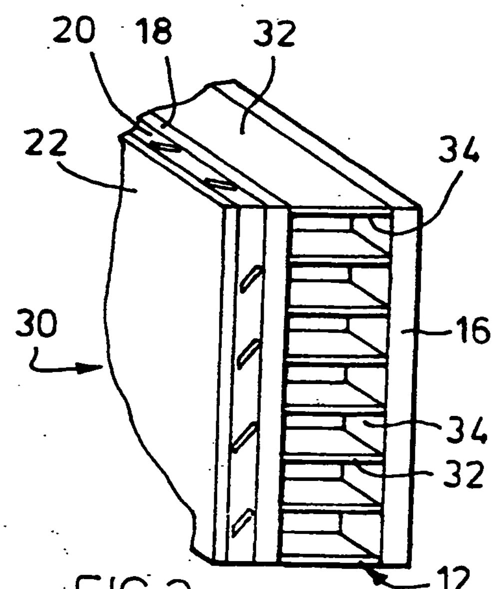

FIG.3

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Heat Shield

This invention is concerned with a shield suitable for use in shielding items from heat. For example, a heat shield according to the invention may be used for shielding a battery mounted in the engine compartment of a vehicle.

The battery of a vehicle is usually housed in the engine compartment thereof and is, therefore, vulnerable to being heated by the heat generated by the engine. Such heating can adversely affect the performance or the life of the battery. For this reason, it is known to provide a battery with a shield to protect it from such heat. Such shields frequently utilise the reflective abilities of metal foil to reflect heat away from the battery and also utilise the insulating properties of materials such as mineral wool or air. Such shields are, however, not as effective as is desirable in some circumstances in preventing the battery from becoming heated. In particular, they are not particularly effective at counteracting transient surges of heat. Such surges occur, for example, from the exhaust system after a prolonged period of high-speed driving when the vehicle comes to rest. The exhaust system becomes very hot internally during high-speed driving but the movement of the vehicle creats an air flow which carries away a considerable proportion of the heat. When the vehicle comes to rest, however, the air flow ceases and the exhaust system may give off sufficient heat to cause damage to an adjacent component. It is found that such transient surges can raise the temperature of a component by 65 degrees

centigrade and last for 5 to 15 minutes after the vehicle stops.

It is an object of the present invention to provide a heat shield which gives more effective shielding than some known heat shields and, in particular, is more effective at counteracting heat surges.

The invention provides a heat shield comprising a containing layer, a working material contained in said containing layer, and sealing layers arranged to seal the working material within said containing layer, the working material being a material which undergoes a reversible phase change from solid to liquid in the temperature range between 40°C and 200°C.

A heat shield in accordance with the invention gives more effective shielding than some known heat shields since not only does it act as a barrier between the heat source and the item being shielded, but it also has the ability to absorb a significant quantity of heat which is used as latent heat in causing the aforementioned phase change. This absorbtion of heat can be utilised to smooth out heat surges with the heat absorbed being released later under cooler conditions when the phase change is reversed, eg on turning off the engine or resuming forward motion. Once the working material has returned to solid form, the heat shield is ready for the next surge of heat.

A wide range of possible working materials is available, particularly hydrates. For example, barium hydroxide hydrate ($Ba(OH)_2.8H_2O$) may be utilised. This material undergoes a change from solid to liquid at 78°C. Alternative working materials (with their melting points) are:
ammonium aluminium sulphate hydrate ($NH_4.Al(SO_4)_2.12H_2O$) - 94°C; calcium nitrate hydrate ($Ca(NO_3)_2.3H_2O$) - 51°C; lithium

borate hydrate ($LiBO_2.8H_2O$) - 47°C; magnesium acetate hydrate - 80°C; potassium aluminium sulphate hydrate ($K Al(SO_4)_2.12H_2O$) - 93°C; sodium aluminium sulphate hydrate ($NaAl(SO_4)_2.12H_2O$) - 61°C and sodium borate hydrate ($NaBO_2.4H_2O$) - 57°C.
Various mixtures may also be used, eg eutectic mixtures.

The containing layer may be absorbent. It may then be in the form of a foam or a felt. An open-cell polyurethane foam is suitable as are foams based on phenolics or melamine formaldehyde. A suitable felt for an absorbent layer may be formed of polyester or glass fibre.

Alternatively, the containing layer may be formed by sheet material, eg polyurethane, which defines a plurality of cavities in which the working material is contained, eg the sheet material may be formed into a honeycomb structure.

The sealing layers must clearly be impermeable to the working material and must be resistant to the temperatures involved. The sealing layers may, for example, be made of a suitable plastics material, eg polyester foil or polyimide foil, or may be a metallic foil.

Preferably, a heat shield in accordance with the invention also comprises a reflective layer to reflect infra-red radiation away from the item being shielded.

Preferably, a heat shield in accordance with the invention also comprises an insulating layer.

A heat shield in accordance with the invention can be in essentially a rigid form, eg it may form a box around or partially around a component. Alternatively, the shield may be in the form of a sleeve to protect a wire or pipe; in which case, it may be flexible.

There now follows a detailed description, to be read with reference to the accompanying drawings, of three heat shields which are illustrative of the invention.

Figures 1 to 3 are diagrammatic, perspective views of of portions of the illustrative heat shields.

The first illustrative heat shield 10, shown in Figure 1, comprises a containing layer 12 which is formed by a rigid sheet of an open-cell polyurethane foam. The shield 10 also comprises a working material 14 absorbed in said layer 12. In this case, the working material is barium hydroxide hydrate which has been absorbed into the foam of the layer 12 by heating the working material until it becomes liquid, which occurs at 78°C, and allowing the liquid to be absorbed into the foam. On cooling, the barium hydroxide hydrate solidifies in the pores of the foam.

The heat shield 10 also comprises sealing layers 16 and 18 which are arranged to seal the working material 14 within the containing layer 12. Thus, when the barium hydroxide hydrate is in liquid form, it cannot escape from the containing layer 12. The sealing layers 16 and 18 are formed of polyester foil and, although this is not apparent from Figure 1, completely surround the layer 12 as the layers are bent into contact with one another around the edges of the layer 12 and are joioned together by liquid-tight joints.

The heat shield 10 also comprises an insulating layer 20 and a reflective layer 22. The insulating layer 20 is formed from aluminium sheet which has been expanded so that it encloses air spaces which serve to reduce the heat which reaches the containing layer 12. The reflective layer 22 is a layer of aluminium foil which reflects infra-red radiation which impinges thereon away from the layer 12.

In the use of the illustrative heat shield 10, the reflective layer 22 relects infra-red radiation back towards the source of heat and the insulating layer 20, and the layers 18, 12 and 16, reduce the quantity of heat which passes through the shield 10. The shield 10 is designed to be used in circumstances in which the working material 14 does not normally reach its melting point. Thus, the working material 14 normally remains in a solid form. However, should a surge of heat occur, the working material may melt, thereby absorbing heat and delaying the transmission of greater quantities of heat to the item being shielded. The barium hydroxide hydrate melts at a temperature of 78°C when which requires latent heat of approximately 88.5 watt hours per kilogram. When cooler conditions prevail, the working material 14 returns to a solid state, giving up the heat which it had absorbed.

The second 28 and the third 30 illustrative heat shields are substantially the same as the first illustrative heat shield 10 except for the form of the containing layer 12 and like parts are indicated by the same reference numerals.

The containing layer 12 of the second illustrative heat shield 28 is made from polyester felt. The working material 14 is absorbed into the felt when in a liquid state.

The containing layer 12 of the third illustrative heat shield 30 is made polyurethane sheet material 32 which defines a plurality of cavities 34. The cavities 34 are of generally square cross-section, in the plane of the layer 12, and are open at the ends facing the sealing layers 16 and 18. Each cavity 34 contains a quantity of the working material 14 (omitted from Figure 3) which is introduced in a liquid state and allowed to solidify in the cavities 34.

CLAIMS

1 A heat shield comprising a containing layer, a working material contained in said containing layer, and sealing layers arranged to seal the working material within said containing layer, the working material being a material which undergoes a reversible phase change from solid to liquid in the temperature range between 40°C and 200°C.

2 A heat shield according to Claim 1, wherein the working material is a hydrate.

3 A heat shield according to either one of Claims 1 or 2, wherein the containing layer is formed by a foam in which the working material is absorbed.

4 A heat shield according to either one of Claims 1 or 2, wherein the containing layer is formed by a felt in which the working material is absorbed.

5 A heat shield according to either one of claims 1 or 2, wherein the containing layer is formed by sheet material which defines a plurality of cavities in which the working material is contained.

6 A heat shield according to any one of Claims 1 to 5, wherein the shield also comprises a reflective layer.

7 A heat shield according to any one of Claims 1 to 6, wherein the shield also comprises an insulating layer.

8 A heat shield substantially as hereinbefore described with reference to, and as shown in, Figure 1, or Figure 2 or Figure 3, of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptr[redacted]r under Section 17
(The Search report)

-7-

Application number
G[redacted]317101.5

Relevant Technical Fields

(i) UK Cl (Ed.L) F2X

(ii) Int Cl (Ed.5) F16L 59/00, 59/02

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASES: WPI

Search Examiner
S R SMITH

Date of completion of Search
3 November 1993

Documents considered relevant following a search in respect of Claims :-
1 to 8

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2242304 A	(BROADGATE) - see lines 1 to 18 of page 2 and lines 6 to 21 of page 9	1,6,7
X	GB 2151410 A	(SUNSTRAND) - see lines 72 to 96 of page 1	1,7
X	GB 1304282	(THERMO) - see line 90 of page 1 to line 28 of page 2 and Figures 1 and 5	1,2

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).